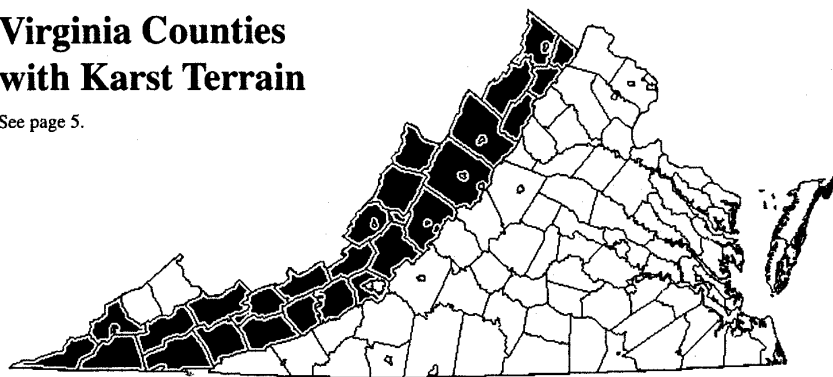


### Virginia Counties with Karst Terrain

See page 5.



## I. PERSPECTIVE

### Steering Committee Completes Tenth Year!

The Ground Water Protection Steering Committee is an inter-agency advisory committee formed to stimulate, strengthen and coordinate ground water protection activities in Virginia. Because of the importance of ground water as a source of water and as a natural resource to Virginia residents, businesses, and industries, the Steering Committee serves an important role in addressing the needs of various ground water users. The Steering Committee, founded in 1986, now includes ten agencies.

Each year since 1988 the Steering Committee has published an *Annual Report*, entitled *Ground Water Protection in Virginia*. These *Annual Reports* serve two main objectives: to educate the people of Virginia about the importance of ground water, and to inform those relying on ground water of state programs and activities that can assist them in ensuring continued quality and availability.

In addition to the *Annual Reports* the Steering Committee has prepared three plans addressing the state of ground water protection in Virginia. The first document was the *1987 Groundwater Protection Strategy for Virginia (Strategy)*. This was followed by the *1990 Supplement*, which assessed the State's progress in implementing actions called for in the *Strategy*. The most recent document is the *1995 Supplement*, which examines the State's progress from 1990 to 1995 in carrying out activities suggested in the *Strategy* and which charts the Steering Committee's course for the next five years.

Two of several accomplishments noted in the *1995 Supplement* were the passage of the Ground Water Manage-

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For more on the Steering Committee, see page 2

ment Act of 1992 and a series of wellhead protection activities. The new law addresses a number of Steering Committee concerns about ground water supply management in the eastern portion of Virginia. The second major accomplishment was the publication of two documents on wellhead protection. *Wellhead Protection: A Handbook for Local Governments in Virginia* was published in 1992 and distributed to local government officials across the Commonwealth. In 1993 documentation of the experience of six jurisdictions was published in *Wellhead Protection: Case Studies of Six Local Governments in Virginia*. Three workshops were held in the summer of 1995 at locations around the state in order to assist local leaders with implementing the recommendations in the two reports.

The Steering Committee has also identified an agenda for 1996 to 2000. A high priority for the next four years is

the continued cooperation and coordination of the Steering Committee member agencies, and increasing education and outreach about ground water to the public. The Steering Committee also wants to expand membership and provide more opportunities for non-member attendees to address the Steering Committee.

In addition the Steering Committee will:

1. Continue to publish its *Annual Reports* and other reports informing Virginia citizens, officials, and businesses about ground water and State programs;
2. Continue to promote voluntary wellhead protection efforts, and testing of private water wells;
3. Reassert the following five priority areas of concern: underground storage tanks, landfills, waste

lagoons, septic tanks, and pesticide and fertilizers;

4. Give a high priority to exploring opportunities for improving research and information collection and dissemination;
5. Continue to seek ways of maximizing the use of limited resources through coordination of activities among state agencies, among localities, between the State and localities, and between public and private entities;
6. Seek ways of improving existing programs, and ways to tie planning for ground water protection to planning for economic development.

For more information about the Steering Committee, contact Mary Ann Massie of DEQ at 804-698-4042.

## GROUND WATER PROTECTION STEERING COMMITTEE MEMBERSHIP

**Department of Environmental Quality (DEQ)** - DEQ strives to provide efficient, cost-effective services in the Commonwealth of Virginia that promote a proper balance between environmental improvement and economic vitality. DEQ is responsible for implementing environmental laws and regulations pertaining to water quality, air quality, solid waste, oil and fuel storage tanks, toxins and more. (Web site: <http://www.deq.state.va.us/>)

**Water Division** contact: Mary Ann Massie, 804-698-4042 ([mamassie@deq.state.va.us](mailto:mamassie@deq.state.va.us)).

**Waste Division** contact: Howard Freeland, 804-698-4219.

**Department of Conservation and Recreation (DCR)** - DCR conserves Virginia's natural and recreational resources. Contact: Stu Wilson, 804-786-4382.

**Department of Health (VDH)** - VDH seeks to equip Virginians to achieve and maintain optimum personal health by emphasizing health promotion, disease prevention and environmental protection. (Web site: <http://www.vdh.state.va.us/>). Contact: Eric Bartsch, 804-786-1760.

**Virginia Cooperative Extension (VCE)** - Virginia Cooperative Extension enables people to improve their lives through an educational process that uses scientific

knowledge focused on issues and needs. Building on the strength of our agriculture, natural resource, family and community heritage, VCE enables people to shape their futures through research based educational programs. (Web site: <http://www.ext.vt.edu>). Contact: Blake Ross, 540-321-4702.

**Department of Agriculture and Consumer Services (VDACS)** - VDACS promotes the economic growth and development of Virginia agriculture, encourages environmental stewardship and provides consumer protection. (Web site: <http://www.state.va.us/~vdacs/vdacs.htm>). Contact: Sara Pugh, 804-786-3539.

**Chesapeake Bay Local Assistance Department (CBLAD)** - CBLAD exists to protect the public interest in the Chesapeake Bay and other state waters by reducing pollution impacts associated with the use and development of land. The Department will accomplish this in partnership with local governments, promoting sound land use planning in a manner that balances the objectives of improved water quality and economic development. Contact: Margie Reynolds, 804-371-7503.

**Department of Mines, Minerals, and Energy (DMME)** - DMME enhances the development and conservation of energy and mineral resources in a safe and environmentally sound manner to support a more productive economy. Contact: Lynn D. Haynes, 540-523-8179 ([ldh@bsgl.mme1.state.va.us](mailto:ldh@bsgl.mme1.state.va.us))

**Department of General Services, Division of Consolidated Laboratory Services (DCLS)** - DCLS provides diversified laboratory services exemplified by their focus on improving total quality and continuing professional excellence. Contact: Ed LeFebvre, 804-786-3767.

**Department of Business Assistance (formerly Department of Economic Development)** - The Department of Business Assistance strengthens the Commonwealth's economy by providing to Virginia businesses value-added services, such as workforce training, financing, and small business development; and through an industry visitation program, serves as state government's principal point of contact and communications with business and industry. Contact: Dave Dickson, 804-371-8215.

**U.S. Geological Survey (USGS), Water Resources Division** - USGS is a federal agency under the Department of Interior, and provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. The USGS, Water Resources Division—Virginia District, is committed to providing the hydrologic information and scientific understanding needed to support the optimum utilization and management of water resources in the Commonwealth of Virginia. (Virginia District's web site: <http://www-va.usgs.gov>; Bureau-wide web site: <http://www.usgs.gov>). Contact: Pixie Hamilton, 804-278-4750.

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## II. ACTIVITIES and SERVICES

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### *Ground And Surface Water Connections*

Out of sight, out of mind? Not true for ground water. Aquifers do not act solely as water "receivers." Nor are they "dead ends" in the hydrologic cycle. Aquifers are equally water "givers." In fact, approximately 30 percent of the flow of surface streams is, on average, contributed by ground water. Streams, lakes, springs, and wetlands continuously receive naturally occurring ground water discharge.

Ground water contribution to surface water bodies, however, varies seasonally and spatially. During periods of heavy rainfall or rapid snowmelt, surface runoff is the primary contributor to stream flow. This is often referred to as "stormflow." During extended dry periods, ground water may be the only contributor to a stream's flow. This is often referred to as "baseflow." Ground water contribution also varies spatially and depends on the geologic conditions, such as unconsolidated sediments in the Coastal Plain and limestone in the Valley and Ridge.

This ground water/surface water connection is increasingly viewed as important and is attracting increasing interest from researchers and public officials seeking to understand the behavior of both types of water.

**Impacts of Nutrients in Ground Water on the Chesapeake Bay** - The U.S. Geological Survey (USGS) has recently initiated a 5-year baywide ecosystem assessment which examines ground water/surface water relations, living resources, and topographic and geologic processes that affect water quality in the Chesapeake Bay. A diverse team of USGS hydrologists, geologists, and cartographers from Virginia, Maryland, and Pennsylvania is conducting a study of the transport of nutrients and sediment into the Chesapeake Bay from its major rivers and from ground water. The investigators are studying the factors controlling relations among land practices, water quality and selected living resources. The information will help resource managers evaluate the effectiveness of management practices in the watershed.

A major activity planned under the program is to quantify the nutrient load entering the Bay from ground water and to identify the effect of residence time of nutrients in the ground water system on water quality response in the rivers and the Bay. Little is known about the effect of elevated nutrients in ground water on the Chesapeake Bay and its ecosystem, but recent studies have shown that the contribution of ground water to this immense estuary might be similar in quantity to that of a major tributary, such as the James River in Virginia. Ground water, like surface water, can carry excessive nutrients from farmers' fields, urban areas, and residential developments. Such nutrients routinely deprive the Bay of the oxygen needed to support more than 2,700 species of plants and animals. The USGS study will help define the role of ground water in the decline of this fragile and immense national treasure. For more information, contact Mike Focazio or Clifton Bell of the USGS, at 804-278-4750.

**Ground Water Sources Under the Direct Influence of Surface Water - The Surface Water Treatment Rule (SWTR)**, as promulgated by the EPA under the Safe Drinking Water Act (SDWA), has for several years begun requiring primacy agencies, such as the Virginia Department of Health (VDH), to identify ground water sources used for drinking water which may be directly influenced by surface water. In situations where a ground water source (such as a well or a spring) is found to be directly influenced by surface water, the waterworks is considered, for regulatory purposes, to be a surface water supply system. Such systems must meet the requirements of surface water systems.

The SWTR was published as a final rule in the June 29, 1989, *Federal Register*. Ground Water Under Direct Influence (GUDI) was defined as ground water which: (1) demonstrated the occurrence of insects, microorganisms, algae, or large diameter pathogens, such as *Giardia lamblia*, or (2) has significant and rapid changes in water characteris-

tics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. States had to conclude their community waterworks evaluations on or before June 29, 1994. Non-community evaluations are to be completed by June 29, 1999.

It is estimated that there are over 3,000 public drinking water systems using ground water sources in Virginia. The VDH Division of Water Supply Engineering (DWSE) began the daunting task of evaluating each of these sources two years ago. In order to efficiently and uniformly make the required determinations, the DWSE, with the assistance of others, developed a protocol to be utilized by its field staff. The protocol uses three basic steps to complete the investigations and make the determinations. The steps are: (1) evaluation of source history; (2) analysis of source physiology and geology; and (3) use of water quality data.

Of the thousands of determinations already made (and tens of thousands of drinking water quality analyses reviewed), 158 sources were found to be GUDI. Ninety-two percent of these are west of the Blue Ridge Mountains. To date, 73 of those waterworks determined to be GUDI waterworks have returned to compliance, either through new sources or surface water treatment of the GUDI source. Eighty-five sources have yet to take action, and the DWSE is working with these waterworks owners to provide for compliance with this important health protection rule.

The GUDI rule is not a static rule. As new water sources are developed or the recharge areas change, the DWSE will continue its assessments. In addition, local health departments will be making the GUDI determination on the non-community water systems to meet the 1999 deadline.

For more information, contact Allen Hammer of VDH at 804-786-6278.

## Agricultural Chemicals Protection Activities

### Pesticide "Clean Day" Approaches

**Half-Way Mark** - The Virginia Department of Agriculture and Consumer Services (VDACS) will be conducting its sixth Pesticide Disposal Program this Fall in 17 localities. This year's localities are the cities of Alexandria, Hampton and Richmond and the counties of Arlington, Brunswick, Charlotte, Hanover, Henry, King William, Loudoun, Lunenburg, Page, Patrick, Shenandoah, Stafford, Surry and York. As in the past, the program is available to agricultural producers, pesticide

dealers and pest control firms in the selected localities. It is estimated that 40,000 pounds of unwanted pesticides will be collected from more than 200 participants. Funding for the program will come from EPA grants to VDACS, the Department of Conservation

and Recreation (DCR) and the Department of Environmental Quality (DEQ).

Since the program's inception in 1990, VDACS has collected over 441,000 pounds of banned, canceled or unwanted pesticides from over 1,100 individuals and firms in 46 counties and independent cities, approximately one-half of the state, at a total direct cost of greater than \$1.4 million. The program has been funded through EPA grants to VDACS, DEQ, DCR and pesticide fees collected by VDACS. No general fund or other state tax dollars have been used to support this effort.

VDACS plans to continue this program and anticipates offering it to remaining Virginia localities with pesticides requiring disposal through 1998. VDACS has submitted grant

proposals to EPA through DCR under the Section 319 Nonpoint Source Program and through the Chesapeake Bay Program to fund the 1997 program.

For more information about Virginia's Pesticide Disposal Program, contact Dan Schweitzer at VDACS, Office of Pesticide Services, 804-371-0152.

**Pesticide Container Recycling Program Enters its Fourth Year** - To assist agricultural producers with the proper disposal of plastic pesticide containers, VDACS is conducting its fourth Plastic Pesticide Container Recycling Program during 1996. The program provides an

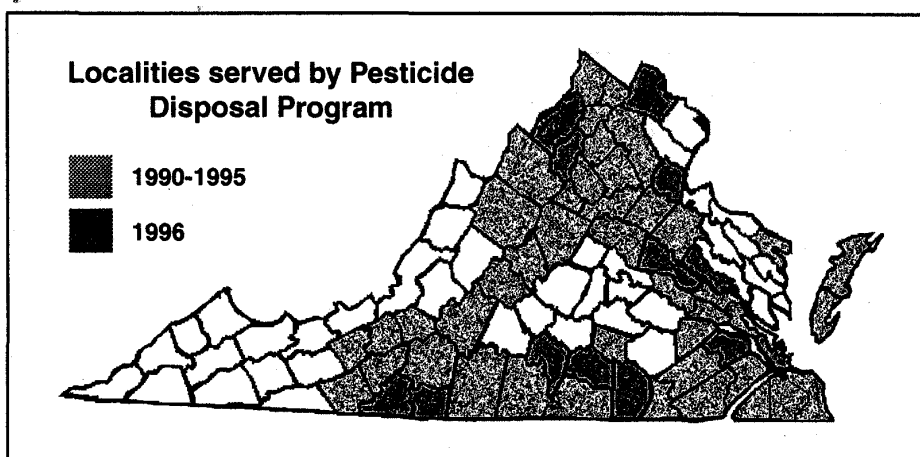
localities and two pesticide dealers participated in the program's initial year, 1993, and the program has grown to seventeen localities and seven dealers in 1996. The number of plastic pesticide containers recycled has also grown from 35,185 containers in 1993 to 53,586 in 1995, a 52% increase, although a recent survey reports that only 28% of the dealers are currently recycling containers, while 66% continue to use landfills (see below). It is anticipated that the growth in the number of participating localities and dealers, as well as the number of pesticide containers, will continue as disposal options become more limited. For more information about the Plastic Pesticide Container

Recycling Program, contact Dan Schweitzer at VDACS, Office of Pesticide Services, 804-371-0152.

**Inventory of Agricultural Chemical Dealers Now Available** - The Department of Biological Systems

Engineering at Virginia Tech, under contract to the Virginia Department of Conservation and Recreation (DCR), recently completed an analysis of a statewide inventory of agricultural mixing and handling facilities. Initially, 243 chemical dealers across the state were mailed a three page survey. From these, a total of 160 surveys were returned for a 65% response rate. The survey contained 24 questions regarding the site location, type of operation and facility, management practices, safety conditions and accidents, an inventory of types and amounts of chemicals handled by each facility, and other pertinent information.

The results of the survey are stored in a geographically referenced database that enables inquiries by county or by



environmentally sound alternative to land filling or burning the empty containers.

Virginia's recycling program is a cooperative effort of VDACS, the Virginia Pesticide Control Board and local governments. It is operated under the guidelines of the Agriculture Container Research Council (ACRC), a consortium of pesticide manufacturers, which coordinates a nationwide program and provides training materials, granulation services and recycling of the plastic.

The recycling program is open to any Virginia locality making application to VDACS for participation. The locality is responsible for coordinating the local program, with VDACS providing funding to offset the local costs for administering the program. Six

*continued on page 8, column 3*

## ***Virginia's Karst Region Presents Challenges***

The karst limestone terrain found in much of western Virginia presents difficult and important challenges to state and local officials as well as farmers, citizens, and businesses. This problem is described in *Wellhead Protection: A Handbook for Local Governments in Virginia* (DEQ, 1992: p. 13):

The connection between ground water and surface water plays a major role in ground water recharge in the Valley and Ridge, where streams often cross fault zones recharging aquifers. Wells in the fault zones have the greatest yields. Recharge also occurs through surface run-off into limestone sinkholes, bypassing filtration through the soil. This can cause serious water quality problems since polluted surface water may be introduced directly into the ground water system. Ground water quality can also be adversely affected

by private trash dumps located in sinkholes that receive surface run-off. In addition, carbonate formations contribute to the "hardness" of the ground water.

The Department of Conservation and Recreation's Karst Ground Water Protection Project was developed to promote awareness of this situation and demonstrate the viability of local karst ground water and other resource management strategies in western Virginia. With assistance from local organizations and agencies, activities in karst terrain which threaten residents' quality of life as well as the habitats of significant biological resources were identified. The project provides basic technical support, citizen-agency coordination and the institutional framework required to meet locally determined karst ground water protection needs.

The project's goals are:

- 1) to protect key karst aquifers bypassed in the historic regional water quality planning process;
- 2) to establish local self-sufficiency, responsibility and consistency in

addressing karst ground water issues through citizen-agency interaction; and

- 3) to develop an incremental, practical approach toward the protection and management of karstlands.

The project seeks to facilitate discussion and resolution of relevant ground water protection issues at local and regional levels. Education and public participation activities are focused on increasing local awareness of karst hazards and stewardship of karstlands through protection planning exercises based on pollution prevention, emergency preparedness and nonpoint source control. A task force of local decision makers, agency technicians, small businesses/landowners and interested citizens will be drafting a regional karst strategy. This will be supported by specialized hands-on training, demonstrations and the development of digital karst value overlays for GIS. Project efforts are expected to enhance all nonpoint source programs that address chronic pollution problems in karst terrain.

For more information on the project, please contact Ms. Terri Brown, Karst Coordinator for DCR, at 540-674-5541.

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## ***Chlorofluorocarbons (CFC's) Can Be Used to Track Ground Water***

Chlorofluorocarbons (CFC's), whose use is rapidly diminishing because of their contribution to ozone depletion, may have at least one redeeming quality - a unique ability to age-date ground water and potentially trace the flow of subsurface ground water contamination. CFC's, a completely artificial product first produced in the 1930s, are used as refrigerants, aerosol propellants, cleaning agents, solvents, and blowing agents in the production of foam rubber and plastics. All CFC's produced are eventually released to the atmosphere. Niel Plummer, Senior Scientist with the U.S. Geological Survey in Reston, Virginia, has developed techniques to relate atmospheric

concentrations of CFC's to concentrations in ground water to determine the ground-water age to plus or minus two years. Although CFC concentrations in ground water are very minute - usually measured in parts per trillion - they can nonetheless be measured with sufficient accuracy to relate to known atmospheric concentrations of the past 50 years.

CFC age-dating is a relatively cheap, easy, and fast hydrologic tool used in many USGS ground water studies. The information can help illuminate how fast ground water moves in the system, and where and when the water recharges the surface. For example, CFC-modeled ages increase with increasing depth in the aquifer and increasing distance along ground-water flow paths. Dominant ground water flow directions are generally west to east. The deep ground water flows along longer paths in the watertable aquifer than does the near-surface ground water and can remain in the

aquifer for several decades before discharging to Magothy Bay in the east.

CFC measurements are effectively used to understand movement of ground water contaminants. Because most contamination originates at the surface, the presence of CFC's in ground water usually indicates a hydrologic pathway that moves contaminants downward. For example, nitrate concentrations are greatest near the land surface, generally representing agricultural land use within 100 to 200 feet of the well. Elevated nitrate concentrations are not limited to near-surface ground water but occur in the deepest parts of the watertable aquifer, about 50 feet below the land surface. The deep ground water flows along longer paths in the watertable aquifer than does the near surface ground water and can remain in the aquifer for several decades. As a result, water from a deep well reflects land use at a distant recharge area rather than land use directly around the well.

## ***Nonpoint Source Watershed Assessments Updated***

The 1996 Virginia Nonpoint Source (NPS) Pollution Watershed Assessment is intended to provide an updated evaluation of the state's waters, on a watershed basis, to assist in targeting NPS pollution protection activities. The 1996 Assessment Report serves as a revision of a similar March 1993 report. It was included within Virginia's Water Quality Assessment 305(b) Report to EPA and Congress and will be published as a separate document later this year. The Assessment Report is currently utilized to target resources in a number of programs, including Virginia's Agricultural Cost Share Program.

In 1989, to assist in watershed-based efforts throughout Virginia, 491 individual watershed units were manually delineated and digitized in a cooperative effort between the Department of Conservation (DCR) and the Natural Resources and Conservation Services (NRCS). The watershed boundaries were established on U.S. Geological Survey (USGS) 1:24,000 series topographical maps. In order to make the hydrologic unit system more compatible with the Department of Environmental Quality's (DEQ's) waterbodies system, the hydrologic unit system underwent a substantial revision in 1995. The resulting delineation consists of 494 individual watershed units within 17 major basins and 47 nationally recognized USGS hydrologic units. Maps that describe these watershed units at several scales are available from DCR, NRCS, and local Soil and Water Conservation District (SWCD) offices.

The basis of the assessment report is an evaluation of NPS pollution potential for each watershed in the state, based on characteristics such as land use, animal densities and other related data. Data were collected to address the NPS potential from three major land use categories: agriculture, urban and forestry. The assessment report ranks each watershed on a comparative basis based on loadings of sediment, nitrogen, and phosphorus from each of these

principle land use categories. Data were initially collected at the county level from various sources, and then disaggregated to the watershed level. The following data sources were used to obtain county level inventory data: 1992 Census of Agriculture (U.S. Department of Commerce, 1989); 1990 National Survey of Conservation Tillage Practices (Conservation Technology Information Center, 1990); and the 1992 Natural Resources Inventory (NRCS). State databases on a watershed level were utilized to include urban disturbed acreage, forest harvesting and site preparation acreage and Best Management Practices (BMP) implementation data. Livestock and poultry inventories, land use, and erosion rates were estimated from the above mentioned sources.

To assist in disaggregating the county data to individual watershed areas, questionnaires were created for each county to be completed by knowledgeable agencies and other local field personnel. Utilizing county level watershed maps, the field personnel allocated and estimated county-level information on land use, livestock and poultry inventories and erosion rates amongst the watershed units. Adjustments to county level data based on local knowledge were also performed. The resulting level of detail allowed for grouping data for analysis and ranking by watershed unit as well as jurisdiction. Water quality monitoring data were provided in the assessment where available to serve as background information and identify watersheds with known water quality problems.

These maps and accompanying information are a valuable compendium of information that many users will find helpful. From a ground water standpoint, it should be acknowledged that ground water was not studied directly. However, given the connection between activities on the surface of the land and ground water and between ground water and surface water, this 1996 Assessment Report may suggest areas which would be candidates for high priority regarding ground water as well as surface water.

For more information, contact Mark Bennett of DCR at 804-786-2064.

## ***New Programs Address Wellhead Protection***

Virginia's community colleges and the National Park Service have joined with EPA to develop two new programs addressing wellhead protection in Virginia. In addition, the Virginia Department of Environmental Quality (DEQ) and the Virginia Rural Water Association have continued their activities on behalf of wellhead protection.

**Community College Program** - EPA Headquarters staff, with assistance from Region III personnel, have initiated a project with Eleni Achellios, program director for Civil Engineering at Tidewater Community College's Virginia Beach Campus. Ms. Achellios incorporated wellhead protection into her introductory engineering course this spring. She and her students completed contaminant source inventories and wellhead protection delineations for 46 ground water based public water supplies in the City of Suffolk. Additional work will be completed this fall as Ms. Achellios incorporates wellhead protection activities for the City of Franklin and the Town of Smithfield into her engineering classes. She reports that this is an excellent opportunity for students to gain field experience as well as to increase the college's outreach and educational efforts in small communities.

Next year, Ms. Achellios will work with three other Community College professors to develop wellhead protection components for Fall semester 1997. If there is enough interest in the program, additional classes may be offered throughout the entire Community College System in 1998. For additional information contact Ms. Achellios at 804/427-7311 or Dale Long, EPA Region III, 215/566-5779.

**Shenandoah Park Pilot Project** - A wellhead protection pilot project, recently completed in the Shenandoah National Park, generated much interest and enthusiasm from administrators for the National Park Service. The project

involved students from James Madison University's Department of Engineering Hydrogeologic Information Center. The students completed delineation and contaminant source inventories at the Big Meadows Visitor Center, where drinking water is supplied by several wells. The National Park Service has expressed interest in completing contaminant source inventories and delineations at all National Parks where ground water is used for Park water supplies. As well as helping to protect Park water supplies, this is an excellent opportunity to inform Park visitors about the benefits of ground water pollution prevention.

The Department of Environmental Quality (DEQ) completed its first Biennial Wellhead Protection Report and submitted it to EPA in October 1995. EPA requires states with EPA approved wellhead protection programs to submit the report. While the Commonwealth does not have an EPA approved program, DEQ staff elected to complete the report to document Virginia's significant voluntary activities.

**Department of Environmental Quality and Virginia Rural Water Association** - DEQ staff worked with EPA Region III staff to complete a map of the Commonwealth showing local wellhead protection activities. Assisting with this project was Ken Coffman, Virginia Rural Water Association's ground water technician, who continues to work with the smaller ground water based water supply systems. Funding for Rural Water Association ground water technicians is provided by the EPA. The Virginia Rural Water Association hosted three one day workshops in 1996 which focused on ground water protection issues and wellhead protection. For information about the Virginia Rural Water Association's wellhead protection program contact Ken Coffman at 540-261-7178.

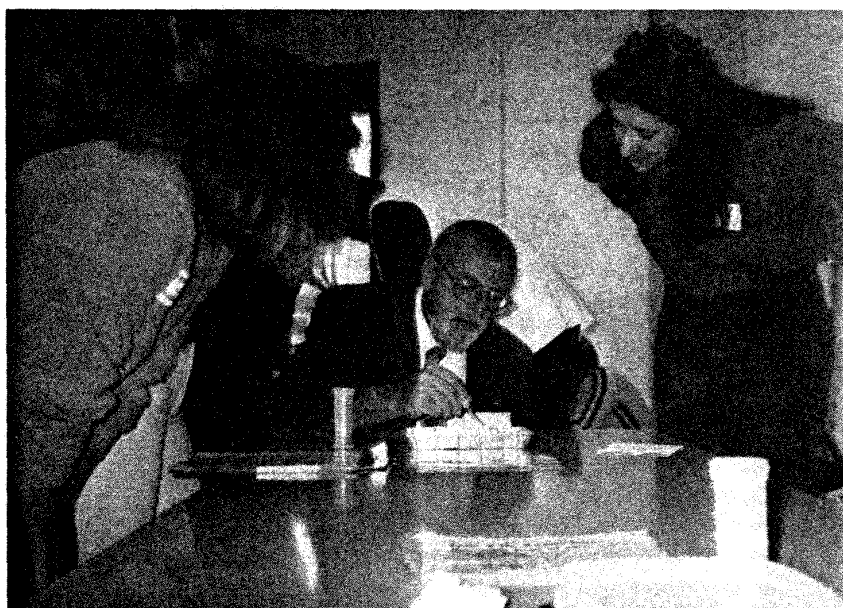
For copies of Virginia's biennial report, as well as more information on wellhead protection in the Commonwealth contact Mary Ann Massie, DEQ, 804-698-4042.

## Virginia Teachers Are Getting WET!

Teachers across the Commonwealth are "Getting the Ground Water Picture", solving "A Grave Mistake," and learning why "Every Drop Counts" through a new national program, *Project WET*. These are just 3 of more than 100 lesson plans found in the *Project WET Curriculum and Activity Guide*, a collection of innovative, water-related activities for grades kindergarten through twelve. The lessons are "hands-on" and incorporate a variety of instructional strategies. The guide addresses the chemical and physical properties of water, quantity and quality issues, surface and ground-

*Project WET* is sponsored by DEQ in conjunction with the Department of Game and Inland Fisheries. With the help of the Department of Conservation and Recreation, another component of the program has been developed - Water Resources Education Trunks. These portable trunks are filled with instructional materials: a ground water flow model; ground water posters; lesson plans and case studies about ground water; and maps, videos, and reference books about other water resources in Virginia, including the Chesapeake Bay. Trunks can be borrowed from most state parks and field offices of the Department of Conservation and Recreation.

*Project WET* materials have been correlated to the Virginia Board of Education's new Standards of Learning



water systems, historic uses of water, and contemporary management issues such as nonpoint source pollution. The program shows that wise water management is essential to the future social and economic prosperity of our country. Lessons are designed to teach students how to think, not what to think, and special emphasis is given to understanding the water needs of all users - e.g., municipalities, farmers, power suppliers, industry, recreationists, and wildlife. The *Project WET Curriculum and Activity Guide* is available in Virginia to all classroom teachers as well as nonformal educators through 6-hour workshops provided by the Department of Environmental Quality (DEQ).

for Science (SOL) and cross-referenced to many of the booklets and pamphlets about Virginia's water resources. For example, a 9th grade Earth Science teacher can easily determine which lesson plans are appropriate for that grade and meet the SOLs and find Virginia-specific background information, such as Ground Water Facts About Virginia, to use. Through these resources today's learners and tomorrow's citizens will view water not only as a shared resource, but also as a shared responsibility.

For more information about the program, contact Ann Regn, Environmental Education Coordinator, DEQ, at 804-698-4442, or e-mail: [aregn@deq.state.va.us](mailto:aregn@deq.state.va.us).

## ***Projects Assess Integrated Crop Management and Best Management Practices***

**Northern Neck** - The Tidewater Resource Conservation and Development Council, Tappahannock, and the Virginia Department of Conservation and Recreation (DCR) are collaborating on an on-farm ground water monitoring program in the Northern Neck. The purpose of the monitoring is to determine the effectiveness of integrated crop management (ICM) utilized by agricultural producers in reducing the concentrations of nutrients and pesticides in the shallow water aquifer. This aquifer is of particular interest because of its interconnection with surface water in this region of the state.

ICM combines nutrient and pesticide management practices into one plan, taking into account on-site physical and environmental factors to determine crop needs while attempting to maximize the efficiency of farming techniques and crop production. The goal is to reduce the actual usage of nutrients and pesticides without harming (or even improving) production, and as a result improve water quality and the economic base for the farming community.

Currently, ICM plans are being implemented at six demonstration sites in the Cat Point Creek watershed in Richmond and Westmoreland Counties. Cat Point Creek is a tributary to the Rappahannock River. Ground water monitoring well clusters (less than 20 feet apart) have been installed at three of the sites. Monitoring was initiated in November, 1995 and is planned to continue through 1998. The wells are monitored monthly for nutrients from July through January and biweekly sampling occurs February through June. Pesticide samples will be collected in the late spring and fall of each year. At that point, results can be compared. Future plans include expanding both the number of ICM implementation sites as well as the number of monitoring sites.

This ground water monitoring project is being funded by a 106 Ground Water Protection grant from the Virginia Department of Environmental Quality and a 319 grant from DCR. For additional information please contact Charlie Lunsford with DCR at 804-371-8984.

**Nomini Creek** - The Nomini Creek Watershed/Water Quality monitoring project was initiated in 1985 to quantify the impacts of agricultural best management practices (BMPs) on improving water quality. The water quality monitoring system was designed specifically to provide a comprehensive assessment of the quality of surface and ground water as influenced by changes in land use, agronomic, and cultural practices in the watershed over the duration of the project. Nomini Creek is characteristic of a coastal plain watershed in Virginia. The primary BMPs which have been implemented are conservation tillage, nutrient management, and structural BMPs in critical areas.

Specific elements of the monitoring system include: wet and dry weather monitoring of the surface and ground water; biological monitoring of streams; analysis of soils for physical and chemical parameters; and the analysis of atmospheric deposition. The primary chemical characteristics monitored include both soluble and sediment-bound nutrients and pesticides in surface and ground water. Data was and continues to be gathered at two fully automated runoff stations and seven rain gauge sites within the 3700 acre watershed. Although existing wells were initially utilized, four pairs of ground water monitoring wells were drilled in 1986 for better quality assurance in ground water sampling. Three additional surface water monitoring sites were added in 1991 as part of the project designed to assess the impacts of BMPs on forestry logging operations in three small subwatersheds within the Nomini Creek watershed. Monitoring was scheduled to conclude in the watershed at the end of June 1996.

Preliminary analysis of the data from Nomini Creek indicates downward trends in both sediment and nutrient losses. Variability in the rainfall from

year to year has added a degree of difficulty in the statistical analysis of the collected data. The current schedule for Nomini Creek calls for intensive analysis of the vast amount of collected data over the next two years. For additional information please contact Mark Bennett of DCR at 804-786-2064.

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### ***Agricultural Chemicals***

*continued from page 10*

watershed. In addition, information concerning operations and facility characteristics is catalogued. The major findings from the survey follow:

- Approximately 56% of the 160 facilities were constructed before 1975.
- Only 12% of the facilities built prior to 1975 have secondary containment.
- Approximately 38% of the pre-1975 facilities use gravel as the surface area material.
- The most common disposal method for pesticide containers is landfills (66%). 28% are returned to the manufacturer or recycled.
- Approximately 78% of the surveys indicated the use of adequately secured areas for chemical storage, 99% of the facilities have conducted the initial employee safety training, and 89% conduct an annual review of safety training.
- Roughly 35% of the facilities are located within 300 feet of a surface water body, and 54% within 300 feet of a water well.

These results reflect both progress and additional needs. The results are now being assessed for their implications for future activities.

For additional information, please contact Charlie Lunsford from DCR at 804-371-8984.

# ***Albemarle County Pilot Project Builds Integrated Digital Hydrogeologic Data Base***

"We just don't have the data" is a common complaint, and one that frustrates efforts to do a better job of planning and decision making with respect to ground water and other natural resources. Now, there may be a solution for this problem, not by collecting more data, but by compiling and integrating data we already have. Such, at least, is the hope in a pilot project involving Virginia's Department of Mines, Minerals, and Energy, Division of Mineral Resources (DMR) and Albemarle County.

The quantity and quality of available ground water vary widely across the Commonwealth. The amount of water and its chemistry is governed to a large extent by the hydrogeologic properties of the rocks surrounding the well. Some hydrogeologic regimes will support continuous extraction of large quantities of high quality ground water without long-term degradation of local or regional ground water reserves. In most areas, however, particularly in Virginia's Blue Ridge and Piedmont regions, ground water is a limited and little known resource. A better understanding of a local or a regional hydrogeologic regime requires accurate, georeferenced, geologic and ground water inventory data, and the ability to integrate the two data sets.

DMR, as Virginia's Geological Survey, is the clearing house for geological data for the Commonwealth. This data comes from many sources, including state and national agencies in addition to private citizens, well drillers, and researchers. DMR is presently in the midst of converting geological data, geophysical data, and mineral resource data into digital form, with the ultimate goal of building a multi-layered state-wide spatial data array that can be accessed electronically. Albemarle County is serving as a pilot project for

developing a digital ground water spatial data base to be integrated with other digital layers containing geologic, geophysical, and remote sensing data. This combined data base will facilitate evaluating the relationships of geologic rock formations and structures to ground water availability and quality.

In the Virginia Piedmont and Blue Ridge, where Albemarle County is located, water well data exist almost exclusively in the form of paper files, and locational information for individual wells is in many cases imprecise. Historically, these limitations have made it difficult to compare geologic map data and ground water data. Water well data entered into the system will be evaluated and attributed in terms of scientific accuracy, and well locations verified using differential Global Positioning System (GPS) devices. The digital ground water data set will be based principally on information contained in completion reports from domestic, public, and industrial water wells.

## **Sources of Ground Water Data:**

Public water supplies The Virginia Department of Health, Office of Water Programs, monitors approximately 100 public water supply wells in Albemarle County. Data are updated periodically, and include well construction engineering characteristics, pumping test data, and water chemistry data.

Community wells The Virginia Department of Health, Thomas Jefferson District, monitors approximately 70 community wells in Albemarle County. Data also include well construction engineering characteristics, pumping test data, and water chemistry data.

Domestic water well completion reports (GW2's) Thousands of water well completion reports reside in filing cabinets at the Virginia Department of Health, Thomas Jefferson District. These reports contain information on well construction characteristics, depth to bedrock, total depth, static water level, and yield. The reliability of the data is variable, depending on how conscientious the driller was in making measurements and recording data.

Hardware River watershed pilot study In 1993 and 1994, Albemarle County Water Resources Manager David Hirshman, in cooperation with state and local agencies including DMR, conducted a study of 90 domestic wells within the Hardware River watershed in southern Albemarle County. Water chemistry data and data contained on water well completion reports (GW2's) are included.

Domestic well water quality study In 1995, Albemarle County and the Virginia Cooperative Extension Service obtained water chemistry data from 500 domestic wells within the County. These data will be linked to data contained on water well completion reports (GW2's).

## **Data Base Construction**

The data base will be developed using a data acquisition template on notebook computers in "Microsoft (MS) Access," a desk-top relational data base. GPS data will be input into the Map Info geographic information system (GIS), which has a module for handling GPS referenced point data, and downloaded into MS Access. The DMR has purchased a Digital Equipment Corporation Alpha 2100 NT server with MS Back Office Suite. When the Alpha 2100 is up and running, the water well data base will be migrated to SQL Server and the data will be made available over the Internet. Customized data sets will be formatted to suit the needs of individual customers and made available on CD-ROM. The lessons learned in Albemarle County will make it clearer how the problem of data integration might best be addressed in the future.

For additional information contact Nick Evans of DMME at 804-963-2317.

## *Virginia's Office of Pollution Prevention - Available For Assistance*

Virginia's Office of Pollution Prevention (OPP) provides a wide range of services and resources which can assist planners, businesses, and individuals in preventing ground water contamination. Located within the Department of Environmental Quality, OPP supports statewide pollution prevention (P2) programs and provides voluntary pollution prevention assistance to businesses and industry, local governments, universities, and community groups. The P2 program also actively promotes pollution prevention education by conducting training workshops and presentations for various audiences statewide. In addition, the office produces P2 publications such as factsheets, a quarterly newsletter, and technical guidance documents for individual Virginia industries.

Pollution prevention began as a state initiative in the Fall of 1988 with the establishment of the Waste Minimization Program in the former Virginia Department of Waste Management (DWM). In 1993, the General Assembly adopted the Pollution Prevention Act and created the Department of Environmental Quality. Multi-media pollution prevention was one of the primary reasons for the creation of the consolidated regulatory agency; later legislation officially created the Office of Pollution Prevention and codified its assistance activities. In 1995, the General Assembly passed a resolution (HJR 453) which requests certain state agencies to work with OPP to develop pollution prevention plans for their facilities.

The core of DEQ's Office of Pollution Prevention is its information clearinghouse which contains factsheets, case studies, publications, journals, videos, and the office's Internet connections with pollution prevention programs across the nation and worldwide. All of this information is available by request, and P2 staff are available to conduct customized research and provide technical guidance. The P2 program includes a staff engineer who provides on-site technical assistance to individual companies and identifies potential

opportunities for pollution prevention. The P2 program also coordinates all statewide pollution prevention initiatives and provides support to pollution programming at state universities, state agencies, localities, and technical centers such as the A. L. Philpott Manufacturing Center, the state's Center for Innovative Technology, and the Virginia Economic Development Partnership's Small Business Development Centers.

P2 activities focus on reducing the quantity and toxicity of waste production which, in turn, results in decreased potential for environmental contamination and decreased costs for waste management and disposal. Inherent to pollution prevention is the premise that it is easier and less costly to prevent pollution than it is to clean up and remediate contamination. For this reason, pollution prevention is recognized as the most cost-effective form of environmental protection.

Pollution prevention activities can be as simple as implementing an improved inventory system or using less toxic cleaning supplies or as involved as major changes in production or investment in more efficient equipment. Through incorporation of basic P2 principles and by changing certain operational and production procedures, businesses can reduce their waste disposal costs and decrease the quantities of materials necessary for production. By using those same practical P2 principles, local governments, community groups, and individuals can decrease their own waste production, reduce the potential for environmental contamination, and save money.

### **Applications to Ground Water Protection**

Many P2 principles and objectives are directly focused on preventing and reducing waste streams which may lead to ground water contamination. Ground water protection efforts are actively benefiting from statewide pollution prevention activities.

Some activities which have the potential to impact ground water include: laundromats/dry cleaners, paints and chemical mixing operations, auto body/garages, car washes, furniture repair and refinishing, photoprocessing, printing, metal parts and equipment cleaning, agriculture, and landscape maintenance. DEQ's P2 program provides technical assistance and guidance for all of these activities, and it has access to a multitude of case studies and other information sources. In addition to these industrial and business applications, DEQ's Office of Pollution Prevention offers guidance documents on practical ways for protecting ground water resources at the office and at home.

DEQ's P2 program would like to become more actively involved in local ground water protection efforts such as wellhead protection, GIS-based ground water planning, and land-use zoning. DEQ's P2 program supports all such planning efforts which strive to reduce potential ground water contamination, and P2 staff are available for assistance. Staff recommend that localities incorporate future ground water protection planning efforts with an aggressive approach to pollution prevention for existing industries, businesses, government, and residential development. Through a combined approach which plans for future development while preventing and reducing pollution in the present, ground water supplies can be effectively protected for future generations.

DEQ's Office of Pollution Prevention encourages you to contact them with all questions and data requests involving pollution prevention principles and activities. The OPP may be reached at 804/698-4384, and is available through the Internet: E-mail at "SKBaxter@DEQ.state.va.us" or "RTGriffin@DEQ.state.va.us". In addition, the OPP maintains an Internet web-page which can be accessed via the DEQ page at "HTTP://www.deq.state.va.us".

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### III. INFORMATION SOURCES

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#### ***Publications Available***

##### USGS:

- *Primer on Ground Water*
- *Ground Water and the Rural Home owner*
- *Selected U.S. Geological Survey publications on the Water Resources of Virginia, 1910-94, Supersedes U.S. Geological Survey Open-File Report 92-69, (available from the Virginia District Office, Richmond, at 804-278-4750)*

- *Ground Water: The Hidden Resource* (Poster)  
Ask for their catalog of titles in the series "General Interest Publications of the U.S. Geological Survey."

Water Information Center (general information): (800) 426-9000 Phone orders, all products: (800) 435-7627

Mail orders: USGS Information Services  
Box 25286  
Denver, CO 80225

- *A Guide to Private Wells*
- *A Guide to the National Drinking Water Standards and Private Water Systems*

Virginia Water Resources Research Center  
Virginia Polytechnic Institute and State University  
10 Sandy Hall  
Blacksburg, VA 24061-0444  
Phone: (540) 231-5624  
Fax: (540) 231-6673

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#### ***Ground Water Finds its Way to World Wide Web Sites***

Ground water is hardly underground on the world wide web! Literally hundreds of web sites contain information of interest to ground water users, program officials, and researchers. Some of the more interesting and useful sites include the following:

The *U.S. Geological Survey Virginia District's* web site listed under the membership roster on page 2, "USGS Programs in Virginia," is full of news, project descriptions, and resources of interest to Virginians. Check it out at <http://h2o.usgs.gov/public/wid/html/va.html>.

Looking for information related to ground water research, legislation, business management, remediation, or any other categories? Check out the *National Ground Water Association Bookstore Catalog*, which claims to be the most comprehensive listing of ground water goods and services in the world - [http://www.h2o-ngwa.org/ctlg\\_mnu.html](http://www.h2o-ngwa.org/ctlg_mnu.html).

Want to find the latest about cryptosporidium, irrigation, pest management, Farm\*A\*Syst/ Home\*A\*Syst, and many other agricultural topics? The program "Agriculture and Water Resources Information," at <http://inform.umd.edu:86/EdRes/Topic/AgrEnv/Water/www.html>, is a service of the *USDA's Water Quality Information Center*.

The *Karst Waters Institute* is a nonprofit organization devoted to improving understanding of karst water systems. Their web site includes an online semi-annual newsletter and links to sites of potential interest to karst researchers - see <http://www.vakron.edu/geology/KWI.html>.

The *Environmental Protection Agency* has made a special effort to promote dissemination of information using electronic resources. The EPA's *Office of Ground Water and Drinking Water* is no exception - view their home page at <http://www.epa.gov/OW/OGWDW/index.html>.

The *National Water Resources Institute* at <http://wrri.eng.clemson.edu/> provides links to many related sites, including the 54 Water Resources Research Institutes in

the 8 regions of the United States. One of those Institutes is the *Virginia Water Resources Research Center* at Virginia Tech, which can be seen at <http://wrri.eng.clemson.edu/va.html>.

*Educating Young People About Water* at <http://www.uwex.edu/erc/ywc/> offers support to individuals and groups that are developing water education programs all over the country. The site focuses on materials that can help users develop a community-based, water education program that targets youth and links key community members in partnerships. The curricula available is searchable by grade level or by subject and includes summaries and checklists.

Finally, if you are interested in participating in mostly technical online discussions, look at the "groundwater.com" site at <http://www.groundwater.com/>. You may subscribe to the *Groundwater Mailing List* from there, or send an e-mail message to [majordomo@ias.champlain.edu](mailto:majordomo@ias.champlain.edu) with the message: subscribe GROUNDWATER (your name).

Look for the Ground Water Protection Steering Committee's own Web site in 1997!

## Did You Know?

Did you know...

### Landfill Facts:

about 40 sanitary landfills in Virginia have implemented an assessment monitoring program after an indication that ground water contamination may have occurred; about 15 sanitary landfills have submitted permit amendments after the determination that there was ground water contamination.

### Underground Storage Tanks:

Since the inception of Virginia's Underground Storage Tank program in October 1989, there have been 9,138 confirmed releases from petroleum storage tanks in Virginia. 6,838 sites have been addressed and resolved, leaving regional staff working on 2,300 sites. 96 carbon filtration units are in operation to provide potable water in instances where installation of a new well or hook up to public utilities is not available.

### Virginia Petroleum Storage Tank Fund Reimbursement Claims -

#### State Fiscal Year Totals (7/1/95 - 6/30/96)

Applications Received -1,637

Applications Processed -1,339

Amount Paid -\$14,400,000

- **Virginia On-Line**

This "world wide web" home page is accessible via the Internet and provides information from a growing range of state agencies and programs. Virginia On-Line's URL address is <http://www.state.va.us/>.

- **Spread the Word**

Do you know of an individual or organization who would benefit from receiving a copy of this and future Annual Ground Water Reports? Call Mary Ann Massie at (804) 698-4042 to add names to the mailing list.

#### State Program Overall Totals (12/22/89 to 5/31/96)

Total number of claims received - 2,892

Total number paid - 1,930

Total number approved but in delayed payment -456

Total number rejected -241

Total number pending -506

Total \$ paid - \$29,000,000

Total \$ pending in delayed payment - \$7,000,000

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*Water quality preservation is everyone's concern.  
If you suspect a pollution incident has occurred, please call:*

**Department of Emergency Services**

**1-804-674-2400 24-hour hotline**

UPJ-963461/1080